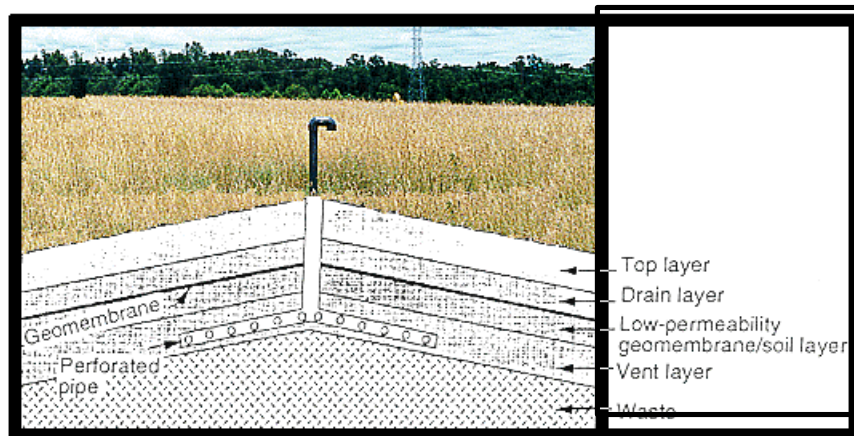




Tennessee Division of Solid Waste Management:

Landfill Gas

Monitoring and Mitigation



March 3, 1999

*The Technical Section
Division of Solid Waste Management
Solid Waste Management Program*

Landfill Gas Monitoring and Mitigation

Table of Contents

<i>Description</i>	<i>Page #</i>
Section 1 - Introduction	1
Section 2 - Tennessee Migration Control Standards.....	1
Section 3 - Landfill Gas Characterization.....	5
Section 4 - Migration of Landfill Gas.....	7
Section 5 - Field Gas Monitoring Techniques.....	9
Section 6 - Landfill Gas Control Systems.....	13
Section 7 - Landfill Gas Safety Guidelines.....	19

Attachments

Attachment 1 - Methane Monitoring Probe Log and Additional Information

List of Tables

Table 1 - Landfill Gas Composition

List of Figures

- Figure 1:** Changes in Landfill Gas Composition Over Time
Figure 2: Lateral Migration
Figure 3: Vertical Gas Migration
Figure 4: Typical Methane Monitoring Well Configuration
Figure 5: Typical Multi-depth Methane Monitoring Well Configuration
Figure 6: CGI Positioned to sample at a Manway
Figure 7: Passive Gas System Using Gravel and Dirt Trap Trench
Figure 8: Passive Gas System Using Gravel and Dirt Trap Trench with Membrane On Back Wall
Figure 9: Typical Detail of an Isolated Gas Vent
Figure 10: Typical Detail of a Passive Gas Venting System w/Header
Figure 11: Typical Gas Extraction Well
Figure 12: Typical Gas Extraction Trench and Header

Bibliography/References

Section 1

Introduction

Tennessee's Gas Migration Control Standards set forth in Tennessee Rule 1200-1-7-.04(5). The regulatory language sets forth, in general terms, the overall goal of gas migration control systems, without providing specific details on how to meet those goals. This document is not intended to represent "hard and fast" requirements which must be adhered to, but is intended to present permit reviewers and other stakeholders with examples of control structures, monitoring structures/devices, etc., for possible incorporation into facility permits and/or operations. The purpose of this document is to clarify the more important gas migration control issues and to provide a structured approach which can be consistently applied by Divisional personnel within all regions of the State. Due to the complexity of the issue, a more detailed treatment concerning Active Gas Collection Systems will be addressed in a future revision.

Section 2

Tennessee Rule Chapter 1200-1-7-.04(5) - Gas Migration Control Standards

This Section consists of the regulatory citations, presented in a "normal" typeface, with appropriate editorial comments presented in italics under the heading "*Discussion*".

- (a) Class I Disposal Facilities must be designed, constructed, operated, and maintained such that any gases generated by decomposition or other reaction of solid waste are collected and vented, recovered, or otherwise managed such that:
 - 1) There is no buildup of gas pressure under the final cover such that the functions of such cover (including any cap) are compromised;

Discussion: *Every Class I, II and III landfill will be required to have some form of gas control system (at least vents), and some facilities will need to have extraction systems. Although the exact quantity and composition of the gases generated will vary, EPA has developed mathematical models which are capable of estimating the amount of methane produced by a given landfill, based largely upon the number of years that the facility has been (or will be) operational, and the annual quantity of Class I wastes received by that facility. A copy of EPA's Landfill Air Estimations Model (Version 1.1) including the manual is available on the EPA World Wide Web at <http://www.epa.gov/>. This software is provided as a tool to be used in approximating the total number of gas vents/collection points which may be necessary. Exact placement of the gas vents/collection points will still need to be determined based on best engineering judgement.*

- 2) The concentration of explosive gases in facility structures (excluding gas control or recovery system components) does not exceed 25 percent of the lower explosive limit for the gases.

Discussion: *Although the regulations include an acceptable methane concentration cap of 25%, there is a safety issue which should be taken into consideration. According to our annual OSHA HAZWOPER training, during an incident response an evacuation is in order whenever 10% of the LEL is exceeded. The rationale for the OSHA 10% LEL evacuation is that explosion meters are not very accurate, and a generous factor of safety is included to ensure that the LEL will never be exceeded (**See Note 1**).*

- 3) The concentration of explosive gases at the property boundary does not exceed the lower explosive limit for the gases.

Discussion: *In order to satisfy this requirement, the facility must conduct methane monitoring in order to verify that the standards are not being exceeded. To comply with this Rule, this monitoring must be done in the subsurface (i.e., “ambient” monitoring by wandering around the site with a handheld monitor does not satisfy this requirement, although “ambient” methane monitoring may still be required under the air regulations). As discussed with respect to the preceding item, setting the explosive gas limit at anything above 10% of the LEL is problematic due to the lack of sensitivity of many of the explosion meters on the market. This issue warrants further investigation. Additionally, if methane is detected in concentrations below 10% of the LEL at the facility boundary, it should be noted and monitored over time to detect any trending which may indicate that a problem is developing.*

- 4) The minimum frequency of monitoring shall be quarterly and the operator shall keep records to comply with the monitoring and records requirements at Rule 1200-1-7-.02(4)(a)9; and monitoring shall include at least the following locations:

Discussion: *Examples of recommended recordkeeping practices are presented in Section 5 of this Document. Sections (i) through (iv) under item 4 (here) are currently being incorporated into the Solid Waste Management Regulations as a part of Revision “m”, and will become effective in the very near future.*

- (i) Underneath or in the low area of each on-site building;

Note 1: *A description of landfill gas monitoring equipment and techniques is presented in Section 5 of this document, and a description of landfill gas safety guidelines is included in Section 7 of this document).*

Discussion: *It is recommended that “underneath” be considered for structures having basements/crawlspaces, and “low area” be considered for slab-foundation structures.*

- (ii) At locations along the boundary shown in the permit;

Discussion: *Notice that this does not state “ [a]t locations along the boundary AS shown in the permit”. The proper determination concerning the number and location of landfill gas probes should largely be a site-specific issue (especially given the geological variation across the State). Section 7 of this document provides some guidance on proper vent/probe installation.*

- (iii) At any potential gas problem areas, as revealed by dead vegetation or other indicators; and

Discussion: *Methane is a potent sufficant for most plant life, and will readily kill grass, trees, shrubs, etc. via simple asphyxiation. Stressed vegetation, especially when evidenced “out of season” or in the absence of a drought, is an excellent indicator of methane migration. In excessive cases, a methane probe will detect methane at or near the ground surface. A better and more sensitive method for qualifying the presence of methane in the vicinity of stressed vegetation would involve digging a small hole with a hand auger, spade or trowel and sealing the hole temporarily by laying a piece of light plastic (e.g., Saran Wrap) over the hole and sealing its edges to the ground with the soil removed from the hole. The sampler can return to the site 24 hours later, insert the probe of the gas monitor directly through the Saran Wrap, and monitor the soil vapor trapped in the hole.*

- (iv) At any other points required by the permit.

Discussion: *It is recommended to include the vapor space in each groundwater monitoring well.*

- 5) Within 60 days of detection above the limits set in parts 1, 2, and 3 of this subparagraph, implement a remediation plan for the methane gas releases. Pending the remediation the owner/operator must take all necessary steps to ensure immediate protection of human health.

Discussion: *Once an exceedence of the standards has occurred the facility must **implement** a remediation plan within 60 days (the wording does **not** state that the facility must submit a plan for approval within 60 days). What this implies is that the facility will work with the Division from the outset to have an acceptable remediation plan implemented (or at least have the implementation underway) by day 60 after detection. Given the short period of time allowed between detection of an exceedence of the standard and remediation implementation, it is highly recommended that facilities have a plan drawn up in the event that an exceedence were to occur. (**See Note 2**).*

- (b) Class II and Class III Disposal Facilities must meet the standards for Class I disposal facilities in subparagraph (a) of this paragraph unless the operator demonstrates to the satisfaction of the Commissioner that, due to the nature of his solid wastes or operation, no significant amounts of gas will be generated within his facility.

Discussion: *The expression “... demonstrates to the satisfaction of the Commissioner ...” means that the facility must successfully petition the Department for a waiver/variance from these requirements. As concerns the appropriate level of effort for gas monitoring (methane, hydrogen sulfide, etc.) at Class III landfills, a review of the incoming waste streams (physical and chemical composition, in-situ moisture content and pH, etc.) is in order to assess the potential of these materials for gas generation. In the event that there is little or no gas generation potential, then the Division may be able to exercise some degree of engineering discretion in the gas monitoring requirements at Class III landfills. Note: There has been some evidence that hydrogen sulfide (H₂S) can be generated in Class II Landfills. Field personnel should be aware of this potential when preparing a permit.*

- (c) Class IV Disposal Facilities shall not be required to have gas migration control features.



Active Gas Extraction Wellhead

Note 2): *Discussions of landfill gas extraction/remediation techniques, and landfill gas control systems are included in this document in Section 6).*

